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STATE OF TENNESSEE

STATE GEOLOGICAL SURVEY

A. H. PURDUE, STATE GEOLOGIST

BULLETIN 15

ADMINISTRATIVE REPORT

OF THE

STATE GEOLOGICAL SURVEY

1912.

A. H. PURDUE,
State Geologist

NASHVILLE
BAIRD-WARD PRINTING CO.
1912

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LETTERS OF TRANSMITTAL

NASHVILLE, TENN., DEC. 19, 1912.

To His Excellency, the Governor, and Members of the Geological Commission:

Gentlemen: In compliance with the law establishing the State Geological Survey, I have the honor to transmit the report of the State Geologist for the term ending December 19, 1912.

Very respectfully,

A. H. PURDUE, *State Geologist.*

DECEMBER 24, 1912.

To the Members of the Fifty-eighth General Assembly of Tennessee:

In accordance with the Act creating the State Geological Survey there is submitted for your investigation, the administrative report of the State Geologist, covering a period from December 19, 1910, to December 19, 1912. We bespeak your careful consideration of the report, showing the extensive field already occupied by the Survey and the work done by it during the two years and eight months of its existence. Respectfully submitted,

BEN W. HOOPER, *Governor, Chairman of the Commission.*
BROWN AYRES, *Secretary of the Commission.*

GEOLOGICAL COMMISSION

GOVERNOR BEN W. HOOPER, *Chairman.*

DR. BROWN AYRES, *Secretary.*
President, University of Tennessee.

CAPT. THOS. F. PECK,
Commissioner of Agriculture.

DR. J. H. KIRKLAND,
Chancellor, Vanderbilt University,

DR. WM. B. HALL,
Vice-Chancellor, University of the South.

GEO. E. SYLVESTER,
Chief Mine Inspector.

THE ESTABLISHMENT OF THE STATE GEOLOGICAL SURVEY

The bill establishing the State Geological Survey, passed the State Legislature of Tennessee in 1909, and is as follows:

CHAPTER 569.

SENATE BILL No. 300.

(By Messrs. Greer, Huffaker, and Neal.)

A BILL to be entitled An Act to establish and create the bureau to be known as the State Geological Survey; defining its objects, powers, and duties; providing for the appointment of a State Geologist, and defining his powers and duties; permitting co-operation with Federal and State bureaus in furthering the objects of this Act; providing for the publication of the results of the survey; providing for the collection of exhibits of the natural resources of the State, and for the final disposition of the equipment and property of the survey; authorizing entrance upon private lands in the prosecution of the work of the survey; and making the appropriations for the enforcement of this Act.

SECTION 1. *Be it enacted by the General Assembly of the State of Tennessee,* That there be, and is hereby, created and established a bureau to be known as the "State Geological Survey," which shall be under the direction of a Commission to be known as the "State Geological Commission," composed of the Governor (who shall be ex-officio Chairman of said Commission), the State Commissioner of Agriculture, the State Mine Inspector, the President of the University of Tennessee, the Chancellor of Vanderbilt University, and the Vice Chancellor of the University of the South.

SEC. 2. *Be it further enacted,* That the said Commission shall have general charge of the State Geological Survey and shall appoint as Director a Geologist of established reputation, who shall be known as the "State Geologist," and upon his recommendation such associate geologists, assistants, and employees as may be necessary to carry out successfully and speedily the work of the survey.

The Director, associates, assistants, and employees appointed under the provisions of this Act shall receive such compensation as shall be determined by the Commission. The said Commissioners shall serve without compenation, but shall be reimbursed for actual expenses incurred in the performance of their official duties.

SEC. 3. *Be it further enacted,* That the said Commissioners shall meet for organization within thirty days after the passage of this Act, and shall appoint a Director as soon thereafter as possible. The regular meetings of the Commis-

sion shall be held on the first Wednesday in May and the first Wednesday in November of each year in such place as the Commission shall determine.

SEC. 4. *Be it further enacted,* That it shall be the duty of the State Geologist, subject to the approval of the Commission, to organize and direct the work of the State Geological Survey in field and office; to determine the character, order, and time of publication of the reports of the survey, and to direct the preparation, printing, and distribution of the same; to arrange for co-operative work with the various Federal and State scientific bureaus where such work shall redound to the interest of the people of the State; to appoint such associates, assistants, and employees as may be necessary to carry out successfully and speedily the work of the survey; to procure and have charge of the necessary field and office supplies and other equipment, and supervise the acquisition, care, and distribution of the collections of the State Geological Survey; and to perform such other work as may be necessary to the successful conduct of the survey. He shall prepare a report to the General Assembly before each meeting of the same, setting forth the progress and conditions of the survey, together with such other information as the Commission may deem necessary and useful.

SEC. 5. *Be it further enacted,* That the said State Geological Survey shall have for its objects and duties the following:

1. A study of the geological formations of the State, with especial reference to their economic products, including coal, oil, gas, ores, fertilizers, building stones, road-making materials, clays, cement materials, sands soils, forests, mineral and artesian waters, drainage of swamps, streams, and water powers, and other natural resources.

2. A study of the character, origin, and relations of the soils of the State, with especial reference to their adaptability to particular crops, the maintenance of soil fertility, and the conservation and utilization of supplies of natural fertilizers.

3. A study of the road-making materials of the State, with reference to their character, distribution, and the best methods of utilizing the same.

4. A study of the occurrence and availability of underground water supplies.

5. An investigation of the forests, streams, and water powers of the State, with especial reference to their conservation and development for industrial enterprises.

6. A study of the swamps and other nontillable lands of the State, with reference to their reclamation for agricultural purposes.

7. A study of the physical features of the State, with reference to their bearing upon the occupations, physical welfare, and intellectual pursuits of the people.

8. The preparation of special reports, with necessary illustrations and maps, which shall embrace both general and detailed descriptions of the geology, topography, and natural resources of the State.

9. The preparation of special geologic, topographic, and economic maps to illustrate the structure, relief, and natural resources of the State.

10. The consideration of such other scientific and economic questions as in the judgment of the Commission shall be deemed of value to the people of the State.

SEC. 6. *Be it further enacted,* That the regular and special reports of the State Geological Survey, with proper illustrations and maps, shall be printed and distributed and sold as the Commission shall deem best for the interest of the people of the State and as said Commission may direct, and all moneys obtained by the sale of said reports shall be paid into the State treasury. The said Commission shall cause to be prepared a report to the General Assembly before each meeting of the same, showing the progress and condition of the survey, together with such other information as they may deem necessary and useful, or as the General Assembly may require; *provided, however,* that the Commission shall have the right to print and distribute said reports.

SEC. 7. *Be it further enacted,* That after having served the purposes of the Survey, all materials collected shall be distributed by the Director to the educational institutions of the State in such manner as the Commission may determine to be of advantage to the educational interests of the State; *provided, however,* that if deemed advisable, the Commission may first use such portion as may be necessary to establish a permanent exhibit of the natural resources of the State. On the completion or discontinuance of the State Geological Survey, the Commission shall cause all records, notes, books, reports, charts, maps, manuscripts, instruments, and other equipment and property of the survey to be placed in charge of a suitable custodian to be held subject to final disposition by the General Assembly; *provided, however,* that any field or other equipment which the commission shall deem it undesirable to preserve may be sold as the Commission may direct and the money turned into the State treasury; and, *provided, further,* that the copies of the reports of the survey left on hand for distribution shall be distributed by the custodian in such manner as shall be for the best interest of the people of the State.

SEC. 8. *Be it further enacted,* That the said Commission is hereby authorized to enter into co-operation with the United States Geological Survey and other scientific bureaus of the Federal and State governments for the prosecution at joint expense of such work in the State as shall be deemed of mutual interest and advantage, and under such conditions as said Commission may deem to be for the best interest of the people of the State.

SEC. 9. *Be it further enacted,* That in order to carry out the provisions of this Act,it shall be lawful for any person employed hereunder to enter and cross all lands within the State; *provided,* that in so doing no damage is done to private property.

SEC. 10. *Be it further enacted,* That for the purpose of carrying out the provisions of this Act, fifteen thousand dollars ($15,000) annually for the years 1910 and 1911, or so much thereof as may be necessary, is hereby appropriated out of any money in the State treasury not otherwise appropriated, and the State Treasurer is hereby authorized to pay out the same on the warrants of the Comptrolier upon the presentation of the proper vouchers by the Chairman of

said State Geological Commission; *provided*, that the appropriation made herein shall not be available until May 1, 1910.

SEC. 11. *Be it further enacted*, That this Act take effect from and after its passage, the public welfare requiring it.

Passed April 30, 1909.

WM. KINNEY,
Speaker of the Senate.
M. HILLSMAN TAYLOR,
Speaker of the House of Representatives.

Approved May 1, 1909.

MALCOLM R. PATTERSON,
Governor.

THE STATE GEOLOGIST.

Dr. George H. Ashley, of the United States Geological Survey, was appointed by the Geological Commission as State Geologist under the recent law, and took charge of the office May 1, 1910. Dr. Ashley at once set vigorously to work to organize the Survey, which he did most effectively, and on the broad lines contemplated in the law making provision for the bureau. But after having served for one year and ten months, he submitted his resignation to accept an offer to return to the United States Geological Survey in an important capacity. His resignation was accepted to take effect March 15, 1912, and Dr. A. H. Purdue, Professor of Geology in the University of Arkansas and State Geologist of Arkansas, was elected to succeed him. Dr. Purdue assumed his duties on the 16th of March, 1912, and has continued the work under the plan of organization of his predecessor, and with practically the same corps of assistants.

STATE GEOLOGICAL SURVEY CORPS.

A. H. Purdue, *State Geologist.*
Wilbur A. Nelson, *Assistant Geologist.*
L. C. Glenn, *Associate Geologist* (Resigned).
C. H. Gordon, *Associate Geologist.*
J. A. Switzer, *Hydraulic Engineer.*
Reese F. Rogers, *Assistant.*
Oscar Jones (temporary), *Topographic Engineer.*
Elizabeth E. Cockrill, *Secretary.*

COOPERATIVE WORK.

Since the last Administrative Report was issued, cooperative work has been arranged by the State Geologist, as provided for by the law establishing the State Geological Survey, with the United States Geological Survey; the Bureau of Soils, Department of Agriculture; and the Forest Service, Department of Agriculture. Arrangements for this work were made by Dr. Geo. H. Ashley before he retired from office. In carrying out this arrangement the State Geologist reports

that the following named persons have spent more or less time in the State:

E. F. Burchard, *U. S. Geological Survey,* Iron.
A. H. Horton, *U. S. Geological Survey,* Water Power of Doe River.
Chas. Butts, *U. S. Geological Survey,* Coal.
E. Russell Lloyd, *U. S. Geological Survey,* Coal.
M. J. Munn, *U. S. Geological Survey,* Oil and Gas.
W. C. Phalen, *U. S. Geological Survey,* Coal.
E. O. Ulrich, *U. S. Geological Survey,* Stratigraphy.
David White, *U. S. Geological Survey,* Stratigraphy.
R. Clifford Hall, *U. S. Forest Service,* Forest Studies.
W. W. Ashe, *U. S. Forest Service,* Forest Studies.
John H. Agee, *U. S. Bureau of Soils,* Soil.
Lewis A. Hurst, *U. S. Bureau of Soils,* Soil.

DRAINAGE PAPERS.

In addition to the above named persons, who represented cooperators with the State Geological Survey, Dr. Geo. H. Ashley, while State Geologist, arranged with Messrs. L. L. Hidinger and Arthur E. Morgan, drainage engineers of Memphis, Tenn., to furnish a paper on "Drainage Problems of Wolf, Hatchie, and South Fork of Forked Deer rivers, in West Tennessee." This paper was published after Dr. Purdue took charge of the office, and appears in Volume 2, No. 6, *The Resources of Tennessee.*

LOCATION OF THE SURVEY.

The State Geological Survey was at first located in the Capitol Annex, on Cedar Street, opposite the Capitol. When it became necessary to tear down this building to open up the Capitol Boulevard another building, known as the General Zollicoffer Building, at No. 312 Sixth Avenue, North, was provided. The State Geological Survey moved into the new quarters January 3, 1912, and at present has some small rooms on the second floor.

NEED OF MORE ROOM.

The present quarters of the State Geological Survey are cramped, inconvenient, and wholly inadequate to its needs. The Geological Commission earnestly request that when provision is made by the State for much-needed permanent quarters for several of the State offices, provision be made for the State Geological Survey in keeping with its scope and purpose.

THE WATER POWER BULLETIN.

The last General Assembly passed the following resolution:

Senate Joint Resolution No. 62.

(By Mr. Bacon.)

WHEREAS, Expenses of carrying on the State's business is increasing with alarming rapidity, making for higher tax rates and increased burdens upon its people; and

WHEREAS, The State is possessed of incalculable wealth in its natural resources in the matter of water power; and

WHEREAS, Other stafes have by the conservation of their natural resources, particularly of the inexhaustible power stored in their streams, been enabled to derive great revenue therefrom, to the end that taxes have been reduced; and

WHEREAS, The water power resources of the State of Tennessee are rapidly passing into the hands of individuals and of corporations, and are not being held and treated as a sacred heritage for future generations to the end that revenue which could and should be derived from this source might pass into the public treasury for the public good and public use; now, therefore,

Be it resolved by the Senate of the Fifty-Seventh General Assembly, the House concurring, That the State Geologist be directed to make a full and careful investigation of the water power resources of the State, and report to the next General Assembly what suitable sites are remaining unappropriated by individuals and corporation, what sites have been so appropriated, what is the value and earning capacity of the latter class, what is the value of those sites remaining, and what would be the probable cost of utilizing them, and what would be their probable earning capacity, which report he shall submit to the next General Assembly, together with a plan of utilizing and enjoying the same.

Adopted July 5, 1911.

N. BAXTER, JR.,
Speaker of the Senate.
A. M. LEACH,
Speaker of the House of Representatives.

Approved July 7, 1911.

BEN W. HOOPER,
Governor.

The resolution as originally drawn contained an item appropriating $5,000 with which to meet its provisions, but this was stricken out. Adequately to have met the requirements of the resolution would have necessitated all the money that it originally provided for, and more. But notwithstanding this was cut out, the resolution as passed seemed to make it imperative upon the State Geologist to meet its requirements as nearly as was possible without money. To that end, cooperative arrangements were entered into with the U. S. Geological Survey for a survey of Doe River, under the direction of Mr. A. H. Horton. Professor J. A. Switzer, of the University of Tennessee, was, upon the recommendation of the State Geologist, elected Hydraulic Engineer of the Survey. Fortunately, Professor Switzer had given the subject of

hydraulic engineering much attention, and especially had studied the potential water power of Tennessee more than any other man. He was therefore able to prepare a bulletin of great value. While it by no means meets the full requirements of the resolution, we feel sure the Fifty-eighth General Assembly will recognize that the former as well as the present State Geologist have done all they could to meet them, with the limited amount of money at their disposal.

The bulletin is in manuscript, awaiting the financial provision by the Legislature for its publication.

EXPOSITIONS.

The National Conservation Exposition will be held in Knoxville, Tenn., during September and October, 1913, and the Panama-Pacific Exposition will be held in San Francisco in 1915.

Inasmuch as the National Conservation Exposition will be held within our State, it is supposed that the Legislature will wish to provide for a creditable exhibit of all the State's resources. At the Panama-Pacific Exposition the Southern States will naturally be expected to have large exhibits. It is presumed that if the General Assembly desires these exhibits made, it will consider the State Geological Survey the best agent to collect and install those representing the mineral resources. As it takes time and much labor to collect a creditable mineral exhibit, we beg to suggest that the appropriation for such at the expositions above named will have to be made by the present General Assembly, and should be made available at once.

THE HERBERT DOMAIN.

As the Herbert Domain is property of the State, and was purchased for coal land, it became a plain duty of the State Geological Survey to investigate the resources of this area. Preparatory to this, a survey for a topographic map of the area was made. The main purpose of this map was to form a base upon which the coal could be mapped, by showing the surface features of the area. The blazed lines that mark the borders of the area were followed in locating the boundaries. According to this map, the area of the Herbert Domain is as follows:

Total area within the boundaries of the Domain.....	9,879.798 acres
Area of the Saratoga Springs tract (within the area but not State property)	115.427 acres
Area of the Domain	9,764.371 acres

The deed of the Herbert Domain calls for somewhat more than 10,925 acres, which is approximately 1,160 acres more than the survey of this bureau shows. We are informed that on account of this

discrepancy between what the deed calls for and what the map of the State Geological Survey shows, the last payment, due January 1, 1913, amounting to more than $15,000, will be held up until an exact survey of the boundaries can be made.

APPROPRIATION REQUESTED.

Among the things that demand immediate attention from the Geological Survey are coal, phosphate, and mineral waters. Full reports on these require a large number of chemical analyses. To the present time the Survey has not had the means to employ a chemist, though one has been much needed from the first. The appropriation heretofore made for the maintenance of the Geological Survey has been at the rate of $15,000 per annum. In order to provide for a chemist, the fitting up of a chemical laboratory, and the employment of one more well equipped, permanent man, which the Survey needs, the Geological Commission respectfully request that the General Appropriation Bill contain an item providing $38,000 for two years for the maintenance of the Geological Survey. This increase of $8,000 over previous appropriations is considered a modest request for an active bureau.

PUBLICATIONS OF GEOLOGICAL SURVEY.

The following publications have been issued by the present Survey:

Bulletin No. 1—Geological Work in Tennessee.

A. The establishment, purpose, object and methods of the State Geological Survey; by Geo. H. Ashley, 33 pages, issued July, 1910, postage 2 cents.

B. Bibliography of Tennessee Geology and Related Subjects; by Elizabeth Cockrill, 119 pages; postage, 3 cents.

Bulletin No. 2—Preliminary Papers on the Mineral Resources of Tennessee, by Geo. H. Ashley and others.

A. Outline Introduction to the Mineral Resources of Tennessee, by Geo. H. Ashley, issued September 10, 1910; 65 pages; postage, 2 cents.

D. The Marbles of East Tennessee, by C. H. Gordon; issued May, 1911; 33 pages; postage, 2 cents.

E. Oil Development in Tennessee, by M. J. Munn; issued January, 1911; 46 pages; postage, 2 cents.

G. The Zinc Deposits of Tennessee, by S. W. Osgood; issued October, 1910; 16 pages; postage, 1 cent.

Bulletin No. 3—Drainage Reclamation in Tennessee; 74 pages; issued July 1910; postage, 3 cents.

A. Drainage Problems in Tennessee, by Geo. H. Ashley; pages 1-15; postage, 1 cent.

B. Drainage of Rivers in Gibson County, Tennessee, by A. E. Morgan and S. H. McCrory; pages 17-43; postage, 1 cent.

C. The Drainage Law of Tennessee; pages 45-74; postage, 1 cent.

Bulletin No. 4—Administrative Report of the State Geologist, 1910; issued March, 1911; postage, 2 cents.

Bulletin No. 5—Clays of West Tennessee, by Wilbur A. Nelson; issued April, 1911; postage, 4 cents.

Bulletin No. 9—Economic Geology of the Dayton-Pikeville Region, by W. C. Phalen, for sale only, price 15 cents.

Bulletin No. 10—Studies of the Forests of Tennessee.

A. An Investigation of the Forest Conditions in Tennessee, by R. Clifford Hall; issued April, 1911; 56 pages; postage, 3 cents.

B. Chestnut in Tennessee, by W. W. Ashe; issued December, 1911; postage, 2 cents.

Bulletin No. 13—A Brief Summary of the Resources of Tennessee, by Geo. H. Ashley; issued May, 1911; 40 pages; postage, 2 cents.

Bulletin No. 14—The Zinc Deposits of Northeastern Tennessee, by A. H. Purdue; issued September, 1912; 69 pages; 30 illustrations, postage, 3 cents a number.

The Resources of Tennessee—This a monthly magazine, devoted to the description, conservation and development of the State's resources. Postage, 2 cents a number.

PRINCIPAL PAPERS.

Vol. I. No. 1—The utilization of the small water powers in Tennessee by J. A. Switzer and Geo. H. Ashley.

No. 2—The Camden chert—an ideal road material, by Geo. H. Ashley.

The Fernvale iron ore deposit of Davidson County, by Wilbur A. Nelson.

Cement materials in Tennessee, by C. H. Gordon.

No. 3—The gold field of Coker Creek, by Geo. H. Ashley.

No. 4—Coal resources of Dayton-Pikeville area, by W. C. Phalen.

No. 5—Economic aspects of the smoke nuisance, by J. A. Switzer.

Watauga Power Company's hydro-electric development, by Francis R. Weller.

The coal fields of Tennessee, by Geo. H. Ashley.

No. 6—Bauxite Mining in Tennessee by Geo. H. Ashley.

A New Manganese Deposit in Tennessee, by Wilbur A. Nelson.

Road Improvement in Tennessee, by Geo. H. Ashley.

Vol. II. No. 1—The Utilization of the Navigable Rivers of Tennessee, by Geo. H. Ashley.

Dust Explosions in Mines, by Geo. H. Ashley.

The Rejuvenation of Wornout Soil Without Artificial Fertilizers, by Geo. H. Ashley.

Tennessee to Have Another Great Water Power by George Byrne.

Manufacture of Sulphuric Acid in Tennessee in 1911, by Wilbur A. Nelson.

No. 2—The Ocoee River Power Development, by J. A. Switzer.
Exploration for Natural Gas and Oil at Memphis, Tenn., by M. J. Munn.

No. 3—The Power Development at Hale's Bar, by J. A. Switzer.
Notes on Lead in Tennessee, by Wilbur A. Nelson.

No. 4—The Tennessee Academy of Science.
The Preliminary Consideration of Water Power Projects, by J. A. Switzer.
Lignite and Lignitic Clay in West Tennessee, by Wilbur A. Nelson.

No. 5—The Growth of Our Knowledge of Tennessee Geology, by L. C. Glenn.

No. 6—On the Impounding of Waters to Prevent Floods, by A. H. Purdue.
Drainage Problems of Wolf, Hatchie, and South Fork of Forked Deer Rivers, in West Tennessee, by L. L. Hidinger and Arthur E. Morgan.
The Waste From Hillside Wash, by A. H. Purdue.

No. 7—Where May Oil and Gas Be Found in Tennessee? By Geo. H. Ashley.
Spring Creek Oil Field, by M. J. Munn.

No. 8—The Monteagle Wonder Cave, by Wilbur A. Nelson.
Cave Marble (Cave Onyx) in Tennessee, by C. H. Gordon.

No. 9—The Valley and Mountain Iron Ores of East Tennessee, by Royal P. Jarvis.

No. 10—The Iron Industry of Lawrence and Wayne Counties, by A. H. Purdue.
Some Building Sands of Tennessee, by Wilbur A. Nelson.

No. 11—Tests on the Clays of Henry County, by F. A. Kirkpatrick. Introduction, by Wilbur A. Nelson.
Barite Deposits in the Sweetwater District, by Herbert B. Henegar.

No. 12—The Soils and Agricultural Resources of Robertson County, by Reese F. Rogers.
The Iron Ore Deposits of the Tuckahoe District, by C. H. Gordon and R. P. Jarvis. Index.

UNPUBLISHED REPORTS.

The following are titles of reports that are yet unpublished, but the manuscripts for which are either completed or well on toward completion. Most or all of these would have been published, but for want of money.

The Water Power of Tennessee, by J. A. Switzer. This brings together all the information we have of the water power of Tennessee, reviews the history

of water power development in other states, discusses water power legislation in the states where that has received most attention, and in the appendix, gives the laws controlling the use of water power in some of the states. This report was written in compliance with Senate Joint Resolution No. 62, Public Acts, 57th General Assembly, 1911, p. 317.

The Iron Ores of the Chattanooga District, by E. F. Burchard.
The Coal Resources of the Crossville Quadrangle, by Chas. Butts.
The Coal Resources of the Herbert Domain, by Wilbur A. Nelson.
Poplar in Tennessee, by W. W. Ashe.
The Soil Survey of Robertson County, Tennessee, by John H. Agee.

MAPS.

A topographic map of the Herbert Domain was published by the Survey in 1911. The Survey for this map was made entirely at the expense of the State Geological Survey, though the work was done by Mr. Oscar Jones, of the U. S. Geological Survey.

In co-operation with the U. S. Geological Survey, a map of the entire State has been prepared, and will soon be out of press. This map is on a scale that has been agreed upon for all the states of the country. One of its uses will be as a base upon which it is the purpose of the State Geological Survey to prepare a geological map of the State.

In 1911, the State Geological Survey, in co-operation with the U. S. Geological Survey prepared a map, known as a map of Pikeville Special quadrangle. A special feature of this map is that it shows the outcrop of the coal beds, and the mines and prospects in the Pikeville area. This was published with Bulletin No. 9, entitled *Preliminary report of the coal resources of the Pikeville special quadrangle of East Tennessee.*